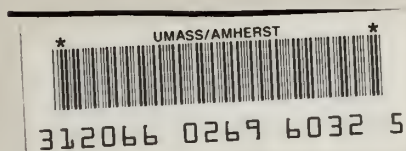
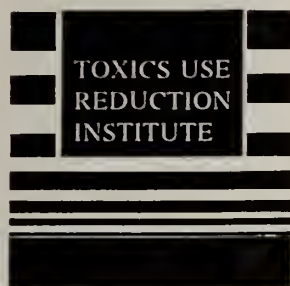


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**THE MASSACHUSETTS
TOXICS USE REDUCTION INSTITUTE**

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**VOC LACQUER REPLACEMENT
FOR WOOD FINISHING**

SMITH & WESSON

Technical Report No. 19

1994

University of Massachusetts Lowell



VOC Lacquer Replacement for Wood Finishing

Smith & Wesson

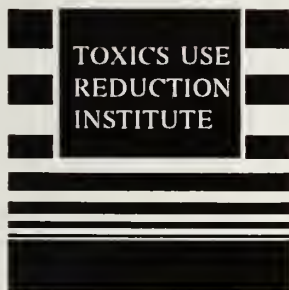
William Serra
Environmental Team Leader

Smith & Wesson
Springfield, Massachusetts

The Toxics Use Reduction Institute Matching Grants Program

December 1994

The Toxics Use Reduction Institute
University of Massachusetts Lowell



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The Toxics Use Reduction Institute is a multi-disciplinary research, education, and policy center established by the Massachusetts Toxics Use Reduction Act of 1989. The Institute sponsors and conducts research, organizes education and training programs, and provides technical support to promote the reduction in the use of toxic chemicals or the generation of toxic chemical byproducts in industry and commerce. Further information can be obtained by writing the Toxics Use Reduction Institute, University of Massachusetts Lowell, One University Avenue, Lowell, Massachusetts 01854.

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Toxics Use Reduction Institute Matching Grants Program

The Institute annually provides direct funding to Massachusetts industries on a matching basis for toxics use reduction (TUR) feasibility and technology studies. The matching Grants Program was initiated in FY 93 to facilitate the development and use of innovative techniques that reduce the use of toxic chemicals or the generation of toxic byproducts in Massachusetts businesses. Grants are awarded on a competitive basis for companies to conduct TUR studies at their facilities. Recipients prepare project reports which assist in transferring toxics use reduction technologies and methods to other companies.

Notice

This report has been reviewed by the Toxics Use Reduction Institute and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Toxics Use Reduction Institute, nor does the mention of trade names or commercial products constitute endorsement or recommendation for use.

EXECUTIVE SUMMARY

Smith & Wesson improved operations by eliminating the lacquer which contained volatile organic compounds (VOCs) in our Stocking Department. The substitution of carnauba wax eliminated VOC lacquer constituents: xylene, n-butanol, MIBK, isobutyl isobutyrate, MEK, toluene, acetone and isopropanol. Smith & Wesson has always been interested in replacing the VOC lacquer with an aqueous-based alternative, but had never found the right product. This project was expedited in April 1993 when Smith & Wesson management challenged members of the Stocking Department to find a suitable alternative to the VOC lacquer presently in use. The project team met this challenge with an alternative process utilizing carnauba wax, a non-toxic, similarly priced product that enhances aesthetics.

BACKGROUND

Smith & Wesson employs 1200 workers at a 600,000 square foot facility in Springfield, Massachusetts. This company's primary product is handguns. Smith & Wesson began the project of replacing the VOC lacquer in April of 1993 and the project completion was December 1993. The product used (VOC lacquer) contained a large amount of toxic constituents. The replacement material (Carnauba Wax) is non-toxic, enhances the aesthetics of our product, and is priced the same as our former product.

TOXICS USE REDUCTION PLANNING

Eliminated from the process are hazardous waste costs generated from the disposal of lacquer sludge and Massachusetts transportation fees. Electrical savings are experienced due to the fact that an 8,000 cfm blower and the DECO spray booth are now shut down. Smith & Wesson also avoided a costly price increase of 100% on the lacquer, because this product contained VOC's in varying amounts.

Various members of the project team included employees from the Stocking Department, Materials Testing Laboratory, Facilities Department, and Marketing Department. All personnel assigned to the project worked on specific assignments and under time constraints. In summary, all milestones were achieved in a very short amount of time due to the efforts of all team members. Special recognition should, however, be given to key individuals who implemented the program from the beginning of the project, they are Gilbert Rosa, Vic Wolejko, and especially Chris Gregoire.

PROJECT SCOPE

Smith & Wesson began a process to evaluate both costs and benefits in order to eliminate our volatile organic compounds (VOC) lacquer used to coat handgun stocks. This lacquer contained the following chemicals: 26% xylene, 15% n-butanol, 18% MIK, 12% isobutyl isobutyrate, 6% nitrocellulose, and 3% I sececoetyl phthalate. In 1993 we used 836 pounds of this material. Smith & Wesson also used, in association with the lacquer, a thinner which contained the following chemicals: 7% MIK, 6% MEK, 6% toluene, 6% acetone, 11% isopropanol, and 4% isobutyrate. In 1993, Smith & Wesson used 385 pounds of this product.

Smith & Wesson has always been interested in replacing this product with an aqueous-based alternative, but had never found the right product. This project was expedited in April 1993 when Smith & Wesson management challenged members of the Stocking Department to find a suitable alternative to the VOC lacquer presently in use.

Several milestones had to be met to ensure success and a task outline was presented to management. Smith & Wesson chose two products to conduct our initial testing on: Smith & Wesson Beeswax and Carnauba Wax. Both items are non-toxic and non-VOC and therefore are excellent candidates for the project.

Smith & Wesson chose in early June 1993 to test the carnauba wax on our combat grips which have a smooth surface. A pilot program was started which resulted in very favorable findings from the beginning. The program was expanded in July 1993. Additional buffing jacks and a new step down transformer were ordered.

Smith & Wesson's main goal was to find a similar wood finish which was equal to the present lacquer coating. What was apparent from the beginning was that the wax actually enhances the aesthetics of the product.

With the success of the Stocking Department and the Marketing Department's approval, the program was expanded and new equipment was installed. Materials testing was an on-going procedure. In September of 1993, the old DECO spray booth was beginning to be phased out.

New equipment for the buffing process of the operation had to be debugged in early October 1993. A new time study of the process was also begun. In November of 1993, test lots of materials were analyzed and evaluated by the Marketing Department and the Material Testing Laboratory. On December 13, 1993, Smith & Wesson decided to replace the DECO spray booth with this new process.

ASSESSMENT AND APPLICATION OF THE TECHNOLOGIES

The VOC lacquer process utilizes a DECO spray unit which deposits finely divided droplets onto a wooded gun stock. The lacquer is applied in two locations on the unit. A water curtain collected the overspray. The overspray reservoir was centrifuged on a daily basis. This material was then removed and placed into a kiln pack for disposal.

This new process consists of a worker placing carnauba wax (see Appendix I for MSDS) onto a buffing wheel and then placing the wooded stock onto the wheel to receive the product. The process is vented only to remove cloth debris which may result from the buffing process. There is no evidence of dust or fumes. The handgun stocks benefit greatly from this new process. The wax penetrates deep into the wood grains which protects the wood from the elements. It also brings out the wood's unique grain patterns which enhances the aesthetics of the product.

Testing was conducted in-house by our Materials Testing Department. The effect on the finish was tested for twenty different chemical agents (reference Appendix II). The wax seemed to repel oils well with no wax deterioration. Solvents and soaps caused discoloration and wax deterioration.

Project Savings and Costs

VOC lacquer hazardous waste disposal	\$3,000
VOC lacquer material costs	\$3,800
VOC lacquer electrical costs	<u>\$3,000</u>
total	\$9,800
New Carnauba wax hazardous waste disposal costs	\$ 0
New Carnauba wax material costs	\$3,000
New Carnauba wax electrical costs	\$ 336
New Carnauba wax equipment installation	\$ 200
New Carnauba wax material testing costs	<u>\$5,000</u>
Initial Investment	total \$8,536

Expected Annual Savings

Electrical costs	\$2,664
Heating/air conditioning costs	\$5,400
Hazardous waste costs	<u>\$3,000</u>
total	\$11,064

Payback Period = 0.8 years

APPENDIX I

RECEIVED APR 14 1993

(1)

MATERIAL SAFETY DATA SHEET
The Mosher Company Inc.
P.O. Box 177
Chicopee, MA 01014
413-598-8341

ISSUE DATE 1/1/92

1. PRODUCT IDENTIFICATION

PRODUCT:
SYNONYMS:
CAS:

Refined #3 N.C. Carnauba Wax
Carnauba Wax
8015-86-9

2. HAZARDOUS INGREDIENTS

NONE

3. HEALTH EFFECT INFORMATION

EYE CONTACT

There are no known health hazards for this product.

SKIN CONTACT

There are no known health hazards for this product.
Molten wax can cause burns.

INHALATION

There are no known health hazards for this product.

INGESTION

There are no known health hazards for this product.

HEALTH DATA

N/A

4. FIRE PROTECTION INFORMATION

Flash Point
Autoignition Temp.

580 F MIN. TEST METHOD C.O.C.
600 F MIN. TEST METHOD C.O.C.

Extinguishing Media

Use dry chemical, foam or carbon dioxide.

Special Fire Fighting
Procedures

Water may be ineffective but can be used to cool containers exposed to heat or flame. Caution should be exercised when using water or foam as frothing may occur.

(2)

Unusual fire and explosive conditions.

Dense smoke may be generated while burning. Carbon Dioxide, Carbon Monoxide and other oxides may be generated as products of combustion.

5. PHYSICAL PROPERTIES

Boiling Point	N/A
Melting Point	181.4 F Min.
Appearance	Tan Flakes
Odor	Odorless
Vapor Pressure	N/A
Solubility	Insoluble in water
Percent Volatile	0%
Vapor Density (Air-1)	N/A
Evaporation Rate (EE-1)	N/A
Specific Gravity	0.996/0.998
Molecular Weight	Varies

6. PERSONAL HEALTH PROTECTION INFORMATION

EYE CONTACT

Eye protection is not required under conditions of normal use. If material is handled such that it could be splashed into eyes, wear plastic face shield or splash-proof safety goggles.

SKIN PROTECTION

Skin protection is not required for short term exposures. For prolonged or repeated exposures use impervious synthetic rubber clothing over parts of the body subject to exposure. If handling hot material use insulated protective clothing.

(3)

RESPIRATORY PROTECTION

Respiratory protection is not required under conditions of normal use. If vapor or mist is generated when material is heated or handled use a NIOSH approved respirator.

VENTILATION

No special requirements under ordinary conditions of use and with adequate ventilation.

7. EMERGENCY & FIRST AID INFORMATION

EYE CONTACT

Immediately flush eyes with large amounts of water. If material is hot, treat for thermal burns and take victim to hospital.

SKIN CONTACT

Remove contaminated clothing. If material is hot, submerge injured area in cold water. If victim is severely burned remove to hospital.

INHALATION

This material has a low vapor pressure and is not expected to present an inhalation exposure at ambient conditions.

INGESTION

There are no known health hazards for this product.

8. REACTIVITY INFORMATION

Stability
(thermal, light, etc.)

Stable, conditions to avoid
(None)

Hazardous Polymerization

Will not occur, conditions to avoid
(None)

Incompatibility

May react with strong oxidizing agents

Hazardous decomposition
product

None

9. ENVIRONMENTAL PRECAUTIONS

Steps to be taken in case
of spill or release

Sweep up material and place in
appropriate disposal container.
If liquid is not attempt to con-
fine spill and let the liquid
solidify. Once solid the product
may be recovered as any other
solid material.

Waste disposal method

All disposables must comply with
federal, state and local regulations
The material spilled or discarded,
may be a regulated waste, refer to
regulations before disposing. If
regulated solvents are used to clean
up spilled material, the resulting
waste mixture may be regulated and
DOT regulations may apply for trans-
porting this material.

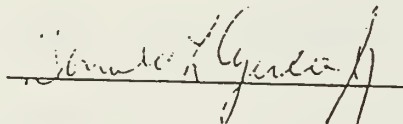
10. MISCELLANEOUS

Molten product may cause thermal burns.

This product has no reporting requirement under SARA TITLE III

THE INFORMATION CONTAINED HEREIN IS BASED UPON DATA AVAILABLE TO
US, AND REFLECTS OUR BEST PROFESSIONAL JUDGEMENT. HOWEVER NO
WARRANTY OF MERCHANTABILITY, FITNESS FOR ANY USE OR ANY OTHER
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RECEIVING IT SHALL MAKE HIS OWN DETERMINATION OF THE SUITABILITY
OF THE MATERIAL FOR HIS PARTICULAR PURPOSE.

ORIGINAL SIGNED BY:



VICE PRESIDENT

APPENDIX II

COATING TEST PLAN

SCOPE:

To determine the affect of mechanical, environmental, and chemical agents on the physical and aesthetic properties of coatings.

SIGNIFICANCE:

The limitations of the results obtained from these tests should be recognized. Chemical agent selection is based upon their general availability to consumers. Time and temperature for chemical immersion are based upon practical experience. For humidity and salt spray testing, time and temperature are outlined in standard test procedures. Data obtained from these tests are of interest only in eliminating the most unsuitable coatings or indicating a probable relative order of resistance to mechanical, environmental, and chemical agents. This test does not address the long term effects of exposure to such agents.

PROCEDURE:

CHEMICAL RESISTANCE. Coated samples are tested mechanically for hardness and weighed. Samples are immersed in chemical agents for 24 hours. At the end of 24 hours, samples are removed and their surfaces dried using the following methods. Samples removed from acid, alkali, or other aqueous solutions are washed with running water and dried with tissue. Hygroscopic or volatile agents which remain adsorbed in the coating or evaporate readily must be handled quickly to avoid added or lost weight do to the pickup or loss of moisture. Samples are reweighed and again tested for hardness. It is important to weigh samples and test for hardness in the order specified so as not to detect any difference in weight which may be a result of hardness testing. A visual examination of the samples is conducted and any noticeable changes (i.e. loss of gloss, developed texture, decomposition, discoloration, swelling, cloudiness, tackiness, rubberiness, crazing, bubbling, cracking, solubility, etc.) are recorded.

CHEMICAL AGENTS: break free oil, detergent, ethanol, Hoppe's #9, kerosene, lacquer thinner, mineral spirits, tap water, ammonie, Armor All, bug spray, Fantastik, furniture polish, K.B. No. 10 Cu Cutter, K.B. No. 10 Solvant, moist gun powder, motor oil, nail polish remover, vinyl cleaner, and WD-40.

CHIPPING RESISTANCE. Impact testing and evaluation is performed on the coating in accordance with ASTM D2794.

HUMIDITY RESISTANCE. 24 hour testing and evaluation performed in accordance with ASTM D2247.

SALT SPRAY RESISTANCE. 24 hour testing and evaluation performed in accordance with ASTM B117.

COATING TEST - A COMPARISON OF WAX ON WOOD STOCKS

CHEMICAL AGENT	BEE'S WAX	CARNAUBA WAX
BREAK FREE OIL	STOCK COLOR CHANGE	STOCK COLOR CHANGE
DETERGENT	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
ETHANOL	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE
HOPPE'S #9	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE
KEROSENE	STOCK COLOR CHANGE	STOCK COLOR CHANGE
LACQUER THINNER	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE
MINERAL SPIRITS	OK	OK
TAP WATER	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
AMMONIA	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
ARMOR ALL	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
BLS SPRAY	STOCK COLOR CHANGE	STOCK COLOR CHANGE
FANTASTIX	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
FURNITURE POLISH	STOCK COLOR CHANGE	STOCK COLOR CHANGE
K.B. NO. 10 OIL CUTTER	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
K.B. NO. 10 SOLVENT	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE
MOIST BUN POWDER	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
MOTOR OIL	STOCK COLOR CHANGE	STOCK COLOR CHANGE
WAX POLISH REMOVER	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
VINYL CLEANER	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE, WAX DETERIORATION
WD-40	STOCK COLOR CHANGE, WAX DETERIORATION	STOCK COLOR CHANGE

COATING TEST - CARNAUBA WAX ON WOOD STOCKS

CHEMICAL AGENT	RESULTS
BREAK FREE OIL	STOCK COLOR CHANGE
DETERGENT	STOCK COLOR CHANGE, WAX DETERIORATION
ETHANOL	STOCK COLOR CHANGE, WAX DETERIORATION
HOPPE'S #9	STOCK COLOR CHANGE, WAX DETERIORATION
KEROSENE	STOCK COLOR CHANGE, WAX DETERIORATION
LACQUER THINNER	STOCK COLOR CHANGE, WAX DETERIORATION
MINERAL SPIRITS	STOCK COLOR CHANGE, WAX DETERIORATION
TAP WATER	STOCK COLOR CHANGE, WAX DETERIORATION
AMMONIA	STOCK COLOR CHANGE, WAX DETERIORATION
ARMOR ALL	STOCK COLOR CHANGE, WAX DETERIORATION
BIG SPRAY	STOCK COLOR CHANGE, WAX DETERIORATION
FANTASTIK	STOCK COLOR CHANGE, WAX DETERIORATION
FURNITURE POLISH	STOCK COLOR CHANGE
K.E. NO. 10 CUTTER	STOCK COLOR CHANGE
K.E. NO. 10 SOLVENT	STOCK COLOR CHANGE
MOIST GUN POWDER	STOCK COLOR CHANGE, WAX DETERIORATION
MOTOR OIL	STOCK COLOR CHANGE
NAIL POLISH REMOVER	STOCK COLOR CHANGE, WAX DETERIORATION
VINYL CLEANER	STOCK COLOR CHANGE, WAX DETERIORATION
WD-40	STOCK COLOR CHANGE



